

African Development Bank Group

Working paper series

N° 139 – November 2011

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Working Paper Series

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Correct citation: Caggiano, Giovanni; Calice, Pietro (2011), The Macroeconomic Impact of Higher Capital Ratios on African Economies, Working Paper Series N° 139, African Development Bank, Tunis, Tunisia.



AFRICAN DEVELOPMENT BANK GROUP

The Macroeconomic Impact of Higher Capital Ratios on African Economies

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Working Paper No. 139

November 2011

Office of the Chief Economist

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Abstract

Motivated by the recent debate on the macroeconomic implications of the new bank regulatory standards known as Basel III, this paper examines the impact of higher capital ratios on aggregate output in a comprehensive panel of African economies. We quantify benefits stemming from lower probability of banking crises due to more stringent capital holdings using a multivariate logit model. Costs, measured as

the impact of higher lending rates premia over deposit rates due to higher capital levels on aggregate output, are quantified using panel data models with fixed effects. We find that there are net benefits associated with tightened capital ratios, and conclude that, by strengthening the resilience of its banking systems, the new global standards might lead to long-term welfare gains for African economies..

Keywords: Basel III, Banking crises, Costs of crises

JEL codes: C23; C25; E44; G01

1. Introduction

Africa escaped the recent global financial crisis relatively unscathed. While the region could not avoid the spillover effects of the ensuing global economic downturn, its banking sector proved generally resilient. This was mainly due to the structural reforms implemented over the past decade, including strengthening the relevant regulatory and supervisory systems within a sounder and more flexible macroeconomic management framework.

Against this background, countries in the region need to advance their financial sector reform agenda. While financial deepening and access to financial services remain the main policy objectives, sustainable and inclusive economic growth rests ultimately on financial stability. In this context, the recent global regulatory response to the financial crisis, in particular the Basel Committee on Banking Supervision's (BCBS) reform package known as Basel III offers a valuable opportunity to reexamine Africa's financial sector reform agenda.

Basel III introduces a comprehensive set of measures which complements the Basel II and Basel I frameworks, with the aim to improve the resilience of banking systems. The cornerstone of Basel III is higher and better quality capital, mostly common equity, with improved absorption features, complemented by newly introduced liquidity requirements (BCBS, 2010a). Other prudential elements of the BCBS package which are relevant for the African banking systems are: i) supplemental Pillar 2 guidance with regards to banks' firm-wide risk management processes and capital planning processes (BCBS, 2009); ii) a leverage ratio expected to work as backstop measure; and, iii) capital conservation and counter-cyclical buffers to help protect banks against excessive credit growth (BCBS, 2010a).²

Africa is making important efforts to move to Basel II. A recent survey conducted by the Financial Stability Institute (FSI) revealed that fifteen African countries as opposed to twelve in a previous survey intend to adopt Basel II by 2015 (FSI, 2010; 2006). There are reasons to believe that the region might benefit from implementing the enhanced Basel II capital framework and the new global micro- and macro-prudential banking standards. First, Basel III can provide a good basis for improving risk management and supervisory practices. Second, a macro-prudential approach to regulation can contribute to improve oversight of systemic risk and

² Key elements of the new capital framework include a minimum common equity Tier 1 ratio of 4.5 percent to be phased in by 1 January 2015 at the latest. The Tier1 capital ratio will be complemented by a capital conservation buffer of 2.5 percent to ensure that banks do not deplete their capital by making distributions to their shareholders, and a countercyclical buffer of up to 2.5 percent, to be activated at the discretion of the designated national authority in case of excessive credit growth. This means that *de facto* under the new regulation banks will be subject to a minimum Tier 1 ratio of 7 percent and a total capital ratio of 10.5 percent. The capital conservation buffer is expected to be phased in by 1 January 2019 at the latest, while the countercyclical buffer is still subject to consultations.

reduce opportunities for capital arbitrage while promoting a level playing field. Finally, heightened capital requirements can contribute to increase the resilience of the financial system.³

In spelling out a strategy to move to Basel III, we believe it is important to assess the implications of regulatory reforms on economic performance, particularly of higher capital requirements, given their potential impact on macroeconomic outcomes. The existence of a “bank capital channel” through which changes in bank capital regulation have macroeconomic implications is well documented in the literature.⁴ During the consultation on the proposed reforms, concerns were raised, among others, that tighter and more demanding capital rules for the banking sector would stifle progress in the recovery of the world economy by negatively affecting the availability of credit supply and ultimately economic growth. In view of these concerns, a number of studies have attempted to assess the macroeconomic impact of the new regulatory standards.

A first strand of the literature is concerned with estimating the net benefits of increased capital ratios in terms of output. The BCBS (2010b) conducted an international assessment to estimate the impact of capital and liquidity reforms on the global economy. The study analyzed the long-term economic costs and benefits for advanced economies. By employing a range of models, it found that, compared to pre-reform state, net benefits range from 0.68 to 1.90 percent of GDP. Barrell et al (2009) investigated benefits and costs of changes in prudential requirements for the U.K. They estimated the benefits of higher capital and liquidity requirements on GDP through a multi-variate logit analysis. Associated economic costs in terms of higher borrowing costs for the household and corporate sectors are calculated through an estimated Dynamic Stochastic General Equilibrium (DGSE) model. They found a positive net benefit from regulatory tightening. For example, an increase of 1 percent in capital and liquidity requirements is associated with a net permanent benefit of 5 basis points of 2009 GDP. More recently, Miles et al (2011) estimated the optimal bank capital levels for the U.K., defined as the level of capital where the marginal benefits of having an extra cushion just falls to the marginal costs of having extra capital. They concluded that the socially-optimal capital ratio is in the 16-20 percent range, when extreme shocks to GDP are not considered, a level which is at least twice as large as the Basel III ratio. The Bank of Canada (2010) performed a cost-benefit analysis of the long-run impact of reforms on the Canadian economy and concluded that the net benefits are likely to be substantial, amounting to 0.8 percent of GDP for an increase of 2 percentage points in the bank capital ratio. In a paper which is closest to ours, Wong et al (2010) provided a cost-benefit analysis of higher regulatory capital levels for Hong Kong. The long-term benefits are again assumed to derive from a lower probability of banking crises based on a logit model, while the costs are mainly reflected in a lower output as a result of higher lending spreads using a vector error-correction model (VECM). They found that higher capital requirements translate into a net benefit for the

³ See, for example, Calice (2010) and Wellink (2011).

⁴ Francis and Osborne (2009a) offer a comprehensive review of the literature on the “bank capital channel”.

Hong Kong economy in the range of 0.02-0.17 percent of real pre-crisis GDP for capital ratios between 9 and 14 percent.

A second strand of the literature focuses only on the costs associated with higher capital requirements in terms of forgone GDP. The Macroeconomic Assessment Group (MAG, 2010a; 2010b), set up by the Financial Stability Board and the BCBS, estimated the short-term transition costs associated with the adoption of the new standards. The results suggest a modest impact on aggregate output. The median reduction in GDP from a 1 percent increase in capital ratios is estimated to be 0.19 percent from the baseline path after four years and half, or a reduction in the annual growth rate of 4 basis points over the same period. Slovik and Cournède (2011) estimated the medium-term aggregate economic costs of compliance with Basel III requirements on the U.S., the Euro Area and Japan combining an accounting-based framework with a global macroeconomic model. They found that meeting the new capital requirements by 2019 would increase lending spreads by 0.5 percent and cost 15 basis points of lower GDP growth per annum. The Institute of International Finance (2010) analyzed the impact of bank regulatory reforms on the global economy. By building a number of accounting frameworks linking the evolution of the banking sector in aggregate with the real economy, it found that the aggregate level of GDP in the U.S, Euro Area and Japan would be 3.1 percent lower in 2015 than it would otherwise be under a scenario with no regulatory reform. Finally, using a VECM, Gambacorta (2011) estimated the long-term economic costs of regulatory reform for the U.S. and found that one percentage point increase in the capital ratio translates into a 0.1 percent drop in the level of steady state output compared to the baseline.

To the best of our knowledge, there is no study that addresses the question of the macroeconomic impact of the new international regulatory standards on developing countries, particularly on African economies. This paper contributes to fill this gap by trying to answer the following question: what is the impact of tighter capital ratios on long-term economic performance in Africa? African banking systems on average already hold capital levels in excess of statutory minimum requirements. Therefore, the objective of this paper is to investigate whether there is still room to raise capital holdings from current levels while achieving net aggregate economic gains. In particular, this paper presents an assessment of the long-term economic benefits and costs of higher capital ratios in terms of their impact on output. Importantly, the aim of the paper is not to provide an estimate of the optimal level of regulatory capital requirements for African banking systems. Consistently with other studies, the focus is on the macroeconomic impact of representative changes in bank capital adequacy ratios based on definitions and historical data that do not correspond directly to those introduced by Basel III. Finally, this study focuses exclusively on the long run, assessing the shift from one steady state to another, and does not consider the shorter-term costs associated with the transition.

To estimate the long-term macroeconomic impact of higher capital holdings on African economies in terms of output, we follow a three-step approach. First, we estimate the long-term benefits. As in related studies (Barrell et al, 2009; BCBS, 2010b; Bank of Canada, 2010; Wong

et al, 2010), we quantify the gains in African GDP resulting from a reduced probability of future banking crises. This involves calculating the expected yearly output gains associated with a reduction in the frequency of banking crises in the continent. This is equivalent to the reduction in the probability of banking crises times the discounted output costs of their multi-year effects. The calculation therefore requires an estimation of the discounted costs of crises and an estimation of the (positive) impact of higher capital ratios on those costs. The estimation of the discounted costs of crises is based on Laeven and Valencia (2010). The mapping of tighter capital ratios into reductions in the probability of banking crises is done based on a multi-variate logit model for a panel of 19 countries for which data are available over the period 1980-2008.

Second, we estimate the long-run economic costs of higher capital ratios on output. This is equivalent to estimating the impact on the cost of bank credit. The higher cost of credit lowers investment and consumption, which in turn affects the steady-state level of output. We use two panel data for 22 countries over the period 2001-2008 to quantify this. In the first model, we analyze the long-run relationship between capital buffers and lending spreads. In the second model, we examine the long-term relationship between lending spreads and GDP.

Finally, we combine the previous results to quantify the net effect of higher capital ratios on aggregate output of African economies. The main result of the paper is that tighter capital ratios have net positive effects on the level of long-run steady-state output for a relatively wide range of capital levels. There are increasing net benefits for capital ratios up to four percentage points higher than the current level. Thereafter, net benefits start decreasing and, for increases in the current capital ratio of more than nine percentage points, the marginal net benefits of higher capitalization turn negative. Given that African banking systems hold on average capital buffers in excess of minimum requirements, the findings of this paper suggest that African regulators should ensure that African banks keep current levels of capitalization at a minimum. One option to influence bank behavior would be to raise capital requirements so as to provide a regulatory floor under current capital ratios. In this context, Basel III offers an important opportunity to strengthen the resilience of African banking systems.

Admittedly, the results of our empirical analysis are subject to substantial uncertainty, reflecting data limitations, the specific models used in the analysis, the cross-country dimension of the study, and the omission of other relevant factors difficult to quantify such as the impact of higher capital ratios on output volatility and the spillover effects from implementation of Basel III in the rest of the world. Nonetheless, we believe this paper provides a broad overview of the long-term economic impact of tightened capital levels on African economies.

The rest of this paper is structured as follows. Section 2 estimates the benefits associated with more stringent capital buffers, in terms of lower expected output losses due to lower frequency of banking crises. Section 3 estimates the costs of tightened capital ratios in terms of forgone output. Combining the results of the previous sections, Section 4 discusses the net benefits of

heightened capital ratios to African economies. Some concluding remarks and policy implications are presented in Section 5.

2. Economic benefits of tightened capital ratios

Tightened capital ratios can have beneficial macroeconomic effects mainly through three channels. First, more stringent capital buffers reduce the probability of systemic banking crises and hence their effects in terms of forgone output. Second, enhanced capital ratios may lead to reduced severity of crises and smaller output volatility, thereby leading to welfare gains. In this section, we focus on the steady-state economic benefits of higher capital levels associated with a reduced probability of systemic banking crisis and with the severity of crisis. We omit the impact on output volatility due to serious data limitations.

The analysis proceeds in two steps. First, we calculate the economic benefits due to a lower probability and severity of banking crises. This requires knowledge of (i) the probability of banking crises; and, (ii) the impact of a banking crisis on output. The probability of banking crises is proxied by the frequency with which banking crises have historically occurred in the region. The impact of banking crises on output is calculated as the cumulative discounted output loss associated with a systemic banking crisis. Second, we estimate the impact of a change in capital ratios on the probability of banking crises. This requires estimation of a multivariate logit model.

2.1. *Benefits from reduced costs associated with banking crises*

Systemic banking crises produce a cost in terms of forgone output: after a crisis, output falls and it takes typically several years before it returns to its old steady state path, or before it reaches its pre-crisis level on a new, permanently lower, growth path.

One way to calculate the macroeconomic impact of systemic banking crises is to estimate the discounted cumulative output loss following a crisis normalized by the trend (see, among others, Laeven and Valencia, 2008; and Cecchetti et al, 2009).⁵ Therefore, the macroeconomic benefit associated with a change in capital ratios is equal to the change in the probability of crises due to the reform times the impact of a crisis in terms of output:

$$\text{Benefit} = \Delta \text{prob} \{ \text{crises} \} \times \Delta \text{GDP}$$

Estimation of the macroeconomic benefits associated with a strengthening of capital buffers, then, must be done using a two-step approach. First, the macroeconomic loss associated with a systemic banking crisis is computed as the cumulative output loss. Second, the impact of the change in capital levels on the probability of crises is estimated using a multivariate logit model.

The probability of banking crises can be reasonably approximated by the frequency with which banking crises have occurred historically. We measure the frequency of banking crises in Africa

⁵ In this case the discount rate equals the trend growth rate.

as the number of crises experienced by African countries between 1980 and 2008 divided by the product of the number of years and the number of countries in the sample, independent of whether countries experienced a crisis or not.

The sample includes 53 countries, observed over 29 years. Based on Laeven and Valencia (2010), we find that the number of crises in Africa is equal to 43, which results in a frequency of crisis equal to 2.7 percent a year.⁶ This is lower than the frequency found for advanced economies: averaging across samples and definitions, Reinhart and Rogoff (2008) find that the frequency of banking crises in G-10 countries is 5.2 percent over the period 1985-2009, while Laeven and Valencia (2008) estimate a 4.1 percent over the same period.

The economic cost associated with banking crises can be calculated in terms of cumulative output loss. There are several approaches that can be applied to calculate forgone output. One approach assumes that the cost of the crisis is temporary and calculates the output loss as the difference between GDP at the peak and i) GDP at the cyclical trough; ii) GDP when the pre-crisis trend growth rate recovers; iii) GDP when the pre-crisis path level is regained. Another approach assumes that the cost of the crisis is permanent and calculates the loss as the difference between GDP at the peak and GDP when the pre-crisis growth rate is regained.

To calculate the discounted output loss for African economies, we refer to Laeven and Valencia (2008; 2010). Based on a combination of quantitative measures and qualitative assessments, the authors define a systemic banking crisis as a situation when a country's non-household private sector experiences difficulties in repaying its obligations fully and timely. They truncate the duration of crises at 5 years, including the first crisis year. Output losses are computed as the cumulative difference between actual and trend real GDP, expressed as a percentage of trend real GDP for the period $[T, T+3]$, where T is the starting year of the crisis. Trend real GDP is computed by applying an HP filter ($\lambda=100$) to the GDP series over $[T-20, T-1]$. This gives, for African countries, a median loss of 33 percent of GDP.

Unlike other related works (see, for example, BCBS, 2010b), we do not distinguish between crises that have no permanent effect on output and crises that have a permanent effect on output. This is motivated by the observation that, in the sample at hand, in no cases a banking crisis has had a permanent effect on the equilibrium path of GDP. This makes the measurement of the expected benefits from reducing the frequency of banking crises trivial. We calculate the economic benefit of enhanced capital requirements due to a lower frequency of banking crisis as the reduction in the annual probability of a crisis times the cost of the crisis, calculated as the discounted present value of the cumulative output loss. This gives an expected annual benefit of reducing the probability of crises by 1 percent equal to 0.33 percent of GDP. With a reduction equal to 2 percent the expected annual benefit would be equal to 0.66 percent of GDP, and so on.

⁶ The assumption is that the length of a crisis is one year. Adjusting for the average three-year duration of crises observed historically in African countries will increase the frequency to 8.5 percent.

These calculations are, however, simply the product of the change in the annual probability of a crisis and the cost if the crisis occurs. Hence, they do not depend on how the reduction in the probability of a crisis is achieved. The next step is to link tighter capital holdings to the change in the probability of a banking crisis.

2.2. The impact of capital ratios on the probability of crisis

We estimate the impact of capital ratios on the probability of crises using a multivariate logit model. The model has become the workhorse in the empirical literature on the causes of banking crises since its introduction in Demirgüç-Kunt and Detragiache (1998). In a logit model, the probability of a banking crisis is assumed to be a function of a vector of potential explanatory variables. Given the hypothesized functional form, typically linear, the estimated logit gives a summary measure of fragility, i.e. the estimated probability of a crisis.

The dependent variable is a binary variable, $P_{t,i}$, which takes a value of 1 at time t if country i has been hit by a crisis at time t , and 0 otherwise. $P_{t,i}$ is assumed to depend on a vector of k explanatory variables, $x_{t,i}$. Let β be the vector of parameters to be estimated, and F the cumulative probability distribution function, assumed to be logistic. Then the log-likelihood function of the model that must be maximized is:

$$Ln(L) = \sum_{t=1}^T \sum_{i=1}^n \{P_{t,i} \ln[F(\beta' x_{t,i})] + (1 - P_{t,i}) \ln[1 - F(\beta' x_{t,i})]\}.$$

It must be noticed that the estimated coefficients would then reflect the impact of a change in the correspondent explanatory variable on $\ln(P_{t,i}/(1-P_{t,i}))$, not on $P_{t,i}$.

We estimate a multivariate logit models for a sample of 19 African countries which have been historically hit by a banking crisis and for which data are available. The countries are: Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Congo (Democratic Republic), Congo (Republic), Equatorial Guinea, Guinea, Guinea-Bissau, Liberia, Madagascar, Mali, Niger, Senegal, Sierra Leone, Togo, Tunisia, Zimbabwe. The estimation of the model is based on annual data for the period 1980-2008.

Following other recent works on the subject (see, among others, Demirgüç-Kunt et al, 2006; Barrell et al, 2010; Wong et al, 2010), we adopt a general-to-specific approach. Our general specification includes as explanatory variables: the capital asset ratio, defined as capital and reserves to total unweighted assets (CAR); the year-on-year GDP growth rate (YG); real GDP per capita (GDPPC); private credit growth (CG); private credit as a ratio of GDP (CGDP); money supply as a ratio of foreign exchange reserves (M2RES); the change in the terms of trade (TOTD); the current account balance (CA); the annual inflation rate calculated as the yearly change in the GDP deflator (INFL); the real interest rate (RIR); and, the rate of depreciation

(DEP).⁷ Robust standard errors have been computed using the Huber-White quasi-maximum likelihood approach. Results of our general-to-specific approach are reported in Table 1.⁸

The general model – Model 1 – has been progressively reduced so to include only those explanatory variables that are statistically significant at least at a 10 percent level. We find that high credit growth, high real interest rates, unfavorable changes in the terms of trade and current account deficits are all positively correlated with the probability of a banking crisis. High GDP growth, in line with the literature that has examined other countries, is robustly significant over all specifications and reduces the probability of a banking crisis. Interestingly, we find that there is a positive and significant effect of an increase in the bank capital-asset ratio: a higher capital-asset ratio is correlated with lower probability of crisis.

Table 1: Banking Crisis Determinants

	Model 6	Model 5	Model 4	Model 3	Model 2	Model 1
CAR	-0.536**	-0.343**	-0.645**	-0.590**	-0.626**	-0.533**
CG(-1)	0.025*	0.025*	0.034*	0.034*	0.033*	0.017
YG	-0.177***	-0.168***	-0.184***	-0.183***	-0.181***	-0.167***
RIR	0.171***	0.171***	0.175***	0.199**	0.197**	0.195**
TOTD	0.027*	0.027*	0.028*	0.028*	0.027*	0.024
CA	0.115**	0.168***	0.169***	0.167***	0.169***	0.149***
CGDP		0.189	0.442	0.452	0.491	0.502
M2RES			-0.271	-0.283	-0.287	-0.230
INFL				0.028	0.024	0.031
GDPPC					-0.001	-0.001
DEP						0.003
Pseudo R-Squared	0.218	0.224	0.232	0.233	0.233	0.218

These results provide interesting insights on the origins of banking crises in Africa. First, the general-to-specific approach leads to identifying three sets of explanatory variables of banking crises in Africa: real economy indicators (GDP growth, the real interest rate), external sector indicators (the current account, changes in the terms of trade), and banking sector indicators (credit growth, the capital-asset ratio). Second, the estimated model allows calculating the expected benefits of a change in capital levels. To do so, we need to calculate the marginal effect of a change in the explanatory variable of interest, i.e. CAR, on the probability of crises. Let x_j be the j -th explanatory variable included in our vector of regressors and y_i the dependent variable, then we need to calculate:

⁷ Data for CAR are taken from the IMF IFS database: line 27A / (line 20 + line 21 + line 22A+ line 22D+ line 27R). Data on GDP growth, Net barter terms of trade, Inflation, Nominal GDP, Money and quasi money to total reserves, Domestic credit to private sector, GDP per capita and Current account balance are taken from the World Development Indicators. All remaining variables are taken from the IMF IFS database.

⁸ Dots denote statistical significance: * denotes 10 percent significance level, ** denotes 5 percent significance level, *** denotes 1 percent significance level.

$$\frac{\partial E(y_i|x_i, \beta)}{\partial x_{ij}} = f(-x_i' \beta) \beta_j$$

where $E(y_i|.)$ denotes the conditional expected value of y_i , β is the vector of parameters and $f(\cdot)$ is the logistic function.

Results show that, for the average capital-asset ratio observed over the period 1980-2008, all other things being equal, the marginal impact of a change in the capital-asset ratio on the probability of crises has been equal to 0.7 percent. This implies that, starting from the observed average capital-asset ratio, a 1 percent increase in the CAR would have decreased the likelihood of a crisis by 0.7 percent, which in turn implies a gain in terms of expected output equal to $0.007 \times 0.33 = 0.23$ percent. For higher levels of the CAR, there are decreasing marginal benefits.

The bank capital ratio used in the analysis is, however, different from the regulatory measure endorsed by Basel III. The next step is therefore to map the results obtained for the capital-asset ratio into the relevant regulatory variable.

2.3. Translating regulatory ratios into bank capital-asset ratio

To measure the effect of a change in regulatory bank capital ratios on the probability of systemic banking crisis and then on GDP, we need to map our bank capital measure, i.e. the capital and reserves to total asset ratio, into relevant regulatory ratio. Basel III has fundamentally tightened the definition of Tier 1 capital, with a stronger emphasis on tangible common equity, while moving away from non-loss-absorbing hybrid instruments. At the same time, the new bank regulatory framework has substantially widened the risk coverage and remodeled risk weightings. Due to data limitations, we use the Tier 1-to-Risk Weighted Assets (RWA) ratio based on definitions under Basel I and Basel II as a proxy for the Basel III capital ratio. The actual values of core capital and RWAs under the new regulation will therefore differ. However, the difference is likely to be negligible. On the one hand, the quality of the core capital base of African banks is typically high due to the general absence of innovative hybrid instruments; on the other hand, credit risk remains the main concern of the banks in the region vis-à-vis market risk.

Like in BCBS (2010b), the mapping of Tier 1/RWA is based on a simple OLS regression of the form:

$$Z_i = \beta X_i + \varepsilon_i$$

where Z_i represents the specific bank capital adequacy ratio defined as capital plus reserves to total assets and X_i is the Tier1/RWA ratio. The regression is weighted based on total assets and is run without constant. Data are taken from Bankscope and cover the period 2001-2008. The sample is composed of 1,065 African banks. Data have been cleaned up of outliers before estimation, leaving a total of 1,061 observations.

Results show that a Tier1/RWA ratio of 21 percent is roughly equivalent to an average ratio of capital and reserves to total assets of 15 percent and is associated with a probability of a systemic crisis of 2.7 percent, which is roughly equal to the historical average experience.

We can now quantify the impact of a change in regulatory capital ratios on the probability of crisis and, in turn, on output. Table 2 shows the results. The second column reports the probability of systemic banking crisis associated with a given Tier1/RWA ratio, as reported in the first column, starting from a level of 20 percent, a 1 percentage point below the observed historical average ratio of 21 percent for the region as a whole. The third column reports the estimated expected output gain due to a 1 percent increase in the Tier1/RWA ratio from the previous level.

Table 2: The impact of capital on the probability of systemic banking crisis

Tier1/RWA (%)	Probability of crisis	Output gain (% GDP)
20	3.20	
21	2.70	0.165
22	2.20	0.165
23	1.83	0.122
24	1.56	0.089
25	1.34	0.073
26	1.18	0.053
27	1.09	0.030
28	1.00	0.030
29	0.95	0.015
30	0.92	0.012
31	0.90	0.007
32	0.88	0.006
33	0.88	0.001

Results show that a 1 percent increase in the regulatory capital ratio relative to the current level would reduce the probability of banking crisis of about 0.5 percent - from a probability of 2.7 percent associated with a Tier1/RWA equal to 21 percent to a probability of 2.20 percent for a Tier1/RWA equal to 22 percent - with an associated output gain of about 0.165 percent. A further 1 percent increase would reduce the probability of banking crisis of another 0.37 percent - from 2.20 percent to 1.83 percent - leading to an overall output gain of 0.12 percent of GDP. Further increases of the Tier1/RWA ratio would still reduce the probability of banking crisis though with a declining marginal contribution.

2.4.The impact of capital requirements on the severity of crisis

Tightened capital levels are expected to reduce not only the probability of occurrence of a systemic banking crisis, but also its severity. Banks entering a crisis with relatively stronger capital ratios are likely to spare the economy some of the costs in terms of forgone output associated with a crisis. This implies that lower capital ratios are likely to be associated with

higher output losses during the ensuing crisis. However, we do not find any statistical support for this conclusion. Based on the sample of 19 countries used in the previous section to estimate the impact of higher capital ratios on the probability of crisis, we regress the cumulative output losses on the capital-asset ratio and find that the regressor coefficient is not statistically different from zero. This result is in line with the findings of BCBS (2010b), and therefore we hold the assumption in the empirical analysis that tougher capital ratios have no impact on the severity of crises.

3. Economic costs of tightened capital ratios

Despite their benefits, heightened capital ratios are likely to impose long-term costs on the economy as banks will try to pass on to their customers the higher cost of funding. The resulting increased cost of financial intermediation would then reduce the level of consumption and investment in the economy, thus resulting in lower output on an ongoing basis. It is worth reminding that the focus of this paper on the steady-state costs leads to discharging potential volume effects derived from more stringent capital holdings. In other words, the steady-state analysis focuses only on price adjustments and does not consider any possible impact on credit rationing. In this section, we estimate the steady-state economic costs, again in terms of forgone output, of higher capital ratios.

Several approaches can be employed to estimate the costs associated with tightened capital levels. Typically, time series models must be used to estimate the long-run impact of changes in capital ratios. These include VECM (see, among others, Gambacorta 2011) and DSGE models (see Christiano et al, 2010). Because of limited data availability and because of the cross-country nature of our study, we adopt a panel data model to estimate the long-run impact of changes in capital buffers.

Our empirical strategy requires a two-step approach. First, we assume that banks pass on to their customers the cost associated with higher capital ratios and estimate the impact of tightened capital ratios on lending spreads, i.e. the lending rate premium over the deposit rate. Second, we assume that the cost of credit has an impact on economic activity through lower consumption and investment and estimate the impact of higher lending spread on output.

To quantify the impact of higher capital levels on lending spreads, we estimate the following panel data model with fixed effects, to account for unobserved heterogeneity across economies:

$$LS_{t,i} = \alpha_i + \beta_1 CAR_{i,t} + \beta_2 ROE_{i,t} + \beta_3 r_{i,t} + \varepsilon_{i,t}$$

where LS is the lending spread calculated as the difference between the lending and the deposit rate; CAR is the capital and reserves to total asset ratio; ROE is the return on equity; and, r is the real interest rate. The panel includes 22 cross-sections observed between 2001 and 2008. The

estimation of the model is based on annual data.⁹ The 22 countries included in the panel are: Algeria, Benin, Burkina Faso, Cameroon, Cape Verde, Central African Republic, Chad, Egypt, Ghana, Guinea, Mali, Mauritania, Morocco, Mozambique, Niger, Nigeria, Senegal, Swaziland, Tanzania, Togo and Zambia. Table 3 shows the results.

Table 3: The impact of capital ratios on lending spreads

Capital-Asset Ratio	0.084*
Return On Equity	0.066**
Real Interest Rate	0.067*
R-Squared	0.758

We find that the capital-asset ratio has a positive and significant impact on lending spreads. In particular, all else being equal, a 1 percent increase in the capital-asset ratio increases the lending spread by about 8.4 basis points. Notice also that the ROE and the real interest rate both enter significantly with the expected sign. When the ROE decreases, banks need to increase the spread they charge to their clients to keep profitability unchanged: all other things being equal, a decrease of 1 percent in the ROE increases the lending spread by 6.6 basis points. Finally, the real interest rate is found to be positively correlated with the lending spread.

The second step requires estimation of the impact of lending spreads on real output. To this aim, we estimate a standard IS relationship augmented with the lending spread. The panel data model is:

$$Y_{i,t} = \mu_i + \gamma_1 LS_{i,t} + \gamma_2 r_{i,t} + u_{i,t}$$

where Y is real GDP.¹⁰ Results are shown in Table 4.

Table 4: The impact of lending spread on output

Lending spread	-0.93133***
Real interest rate	-0.0377**
R-Squared	0.810

We find that the lending spread enters significantly at all levels and with a negative sign. In particular, the estimated panel data model suggests that a 1 percent increase in the lending spread decreases output by about 93 basis points. As expected, the real interest rate is also significant at a 5 percent level and negatively correlated with output, as implied by the textbook downward sloping IS curve.

⁹ Data for lending spreads, CAR and real interest rates are taken from the IMF IFS database. Data on ROE are taken from Bankscope. We include in the model all countries for which we find data, except Zimbabwe which, because of hyperinflation, represents a clear outlier.

¹⁰ Data for real GDP are taken from the World Development Indicators.

The final step of our empirical analysis of the costs associated with more stringent capital ratios is to map the results obtained for the capital-asset ratio into the relevant regulatory variable. Given the 1.44:1 relationship between CAR and Tier1/RWA previously estimated, a 1 percent increase in the Tier1/RWA ratio implies an increase of about 6 basis points in the lending spread. In turn, this implies that a 1 percent increase in the Tier1/RWA ratio would have a cost in terms of GDP of about 0.056 percent. Importantly, as the models employed to estimate the long-run costs of higher capital ratios are linear, the effects of tightened capital holdings are linear as well. That is, a doubling of the increase in capital doubles the effect on output and so on. This implies that, differently from the estimation of the benefits, the starting level of capitalization does not matter. Table 5 summarizes the long-run impact of Tier 1/RWA on lending spreads and on output.

Table 5: Impact of increases in Tier 1/RWA on lending spread and GDP

Tier1/RWA	Change in lending spread	Change in GDP
+2%	0.121%	0.113%
+4%	0.242%	0.225%
+6%	0.363%	0.338%
+8%	0.484%	0.451%
+10%	0.726%	0.676%
+12%	0.968%	0.901%

4. Costs and benefits compared

This section brings together the findings of the previous sections to derive a summary calculation of the long-term economic impact of higher capital ratios. Table 6 provides summaries of the results from the previous sections of the paper. They show the estimated benefits and costs and corresponding net benefits measured by the percentage change in the yearly level of GDP for hypothetical increases in capital ratios. The results are relative to the pre-reform steady-state, proxied by the historical average of the Tier 1/RWA ratio and the frequency of banking crises.

Table 6: Expected annual benefits and costs of tighter capital ratios (in terms of GDP level)

Change in Tier1/RWA	Expected benefits (%)	Expected costs (%)	Net benefits (%)
2%	0.287	0.113	0.174
4%	0.448	0.225	0.223
6%	0.532	0.338	0.194
8%	0.576	0.451	0.125
10%	0.595	0.676	-0.081
12%	0.602	0.901	-0.299

The main conclusion is that the expected long-term net benefit for Africa is estimated to be positive for a broad range of the Tier 1/RWA ratio. Net benefits are found to be positive when the Tier 1/RWA is increased by up to 9 percent from current levels. There are increasing marginal net benefits up to a Tier 1/RWA of about 26 percent, or 5 percentage points higher than

current levels, after which they start declining and eventually turn negative when the Tier 1 ratio reaches 30 percent.

Starting from different capital levels reflecting different initial conditions, these results are broadly in line with those found for advanced economies, although their magnitude is lower, reflecting milder gross benefits for Africa (see Chart 1). This is due to the fact that, starting from different capital levels, marginal reductions in the probability of banking crises induced by heightened capital ratios are found to be lower for African countries, probably reflecting in part the relatively stronger capitalization of the African banking systems (see Chart 2). Moreover, output losses associated with systemic banking crises in Africa are found to be milder than the average estimated for advanced economies, possibly due to the fact that in Africa no crisis with a permanent effect on output was observed.

Chart 1: Estimated gross benefits (% of GDP)

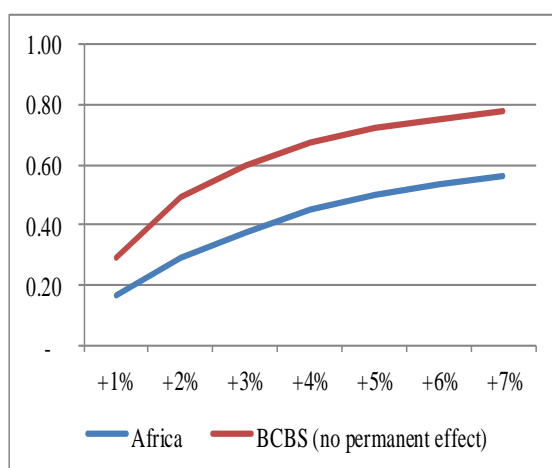
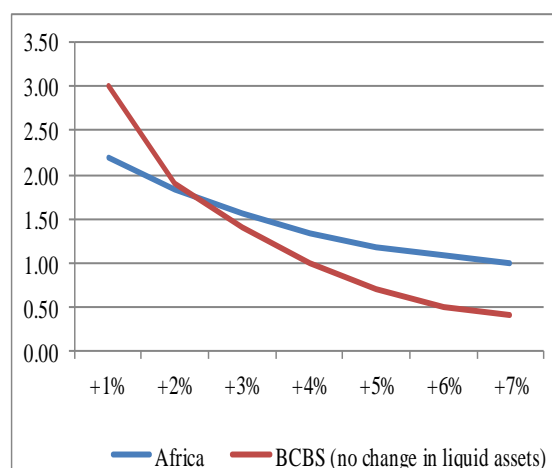
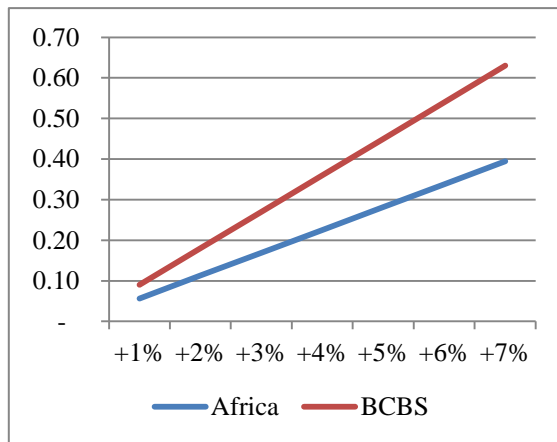
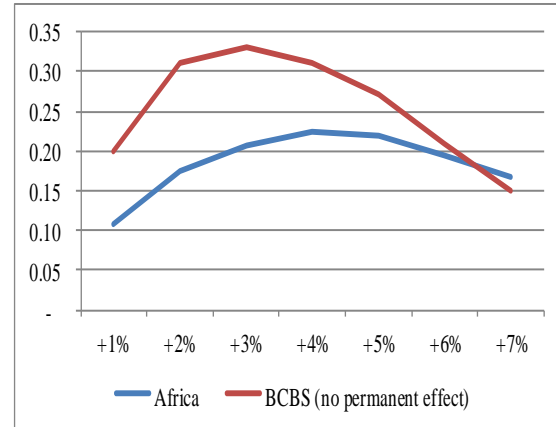


Chart 2: Probability of banking crisis (%)



Our results show also that the estimated gross economic costs are lower for Africa than for advanced economies (see Chart 3). For example, we find that a one percent tightening in the capital ratio is associated with a loss of 5.6 basis points in terms of GDP in the long-run, whereas the median cost estimated for advanced economies is 9 basis points (BCBS, 2010b). As the economic costs of tightened capital ratios are assumed to be transmitted to the economy through higher lending spreads, these results might reflect the fact that interest rates in Africa are in general relatively high and therefore their marginal impact on investment and consumption is likely to be smaller than in advanced economies.

Chart 3: Estimated gross costs (% of GDP)**Chart 4: Estimated net benefits (% of GDP)**

It is important to stress that these conclusions are subject to a number of caveats. First, there is uncertainty surrounding the estimates of the benefits because the measure of capital used on the multivariate logit is not the same variable targeted by regulators. The impact of official measures has been implied by mapping the capital-asset ratio into the Tier1/RWA ratio, used as a proxy for the regulatory capital ratio. Second, data availability for African countries is limited. A longer span of the data would have increased the confidence of estimating the long-run impact on GDP of higher lending spreads. Third, our estimates are clearly subject to the Lucas' critique. More robust estimates would have been based on DSGE models, but data limitations have prevented to pursue this alternative empirical strategy.

Moreover, similar to BCBS (2010b), a number of other possible long-term economic benefits and costs arising from higher capital ratios have not been taken into account. These include, among others: i) the possible underestimation or overestimation of the costs in terms of forgone output associated with banking crises, including a failure to correctly detect causal directions; ii) the likely positive effect that higher capital ratios have on smoothing the cyclicalities of credit supply, which in turn affects the amplitude of the business cycle; iii) the possible adjustment in banks' business models and operations induced by heightened capital levels, which may soften the full pass-through hypothesis of higher cost of funding, thus reducing the long-run costs; and, iv) the spillover effects from implementation of the new standards in the rest of the world, which might affect African economies through both the trade and the financial channel.

5. Conclusions and policy implications

Motivated by the recent debate on the macroeconomic implications of the new regulatory standards, the so-called Basel III reform, this paper assesses the long-term economic benefits and costs of higher capital ratios for African economies. In particular, this paper estimates the impact of tightened capital holdings on economic performance measured by changes in the steady-state level of GDP.

Adopting a methodology used in similar studies (Barrell et al, 2009; BCBS, 2010b; Bank of Canada, 2010; Wong et al, 2010), we first quantify the gross benefits in terms of gains in African GDP resulting from a reduced probability of future banking crises. Based on existing data on the historical frequency of systemic banking crisis and associated output losses in Africa documented in Laeven and Valencia (2010), we map higher capital ratios into reductions in the probability of crisis using a multi-variate logit model for a panel of 19 countries over the period 1980-2008. We then estimate the long-run economic costs of higher capital ratios on output employing two panel data for 22 countries over the period 2001-2008. The first model analyzes the long-run relationship between capital holdings and lending spreads. The second model examines the long-term relationship between lending spreads and GDP. We finally combine the estimated costs and benefits to quantify the net effect of higher capital ratios on aggregate output of African economies.

The results of the empirical analysis show positive net benefits from capital tightening, with output gains for increased regulatory capital ratios up to 9 percentage points relative to current levels. Starting from different levels of capitalization of the banking sector, which reflect different initial conditions, net benefits for Africa are found to be lower than those estimated for advanced economies, with both lower expected gross benefits and costs.

The findings of this paper suggest that there are marginal net macroeconomic benefits from increasing capital adequacy ratios of African banking systems from current levels. However, there are even more substantial gains to be made from preventing African banking systems from reducing their capital levels below existing levels. African banks hold on average considerably more capital than required by regulators. Actual Tier 1 regulatory capital ratios are close to 21 percent on average while minimum Tier 1 capital requirements range from 4 percent to 8 percent. This implies that African banks can reduce their capital levels by more than half on average and still meet the solvency test. A key question for African bank regulators is, therefore, how to ensure that banking systems maintain current levels of capitalization and possibly raise their capital ratios. One option would be to increase minimum capital requirements so as to institutionalize current capital levels. Previous research primarily focusing on advanced economies shows that risk-based bank capital ratios respond to changes in capital requirements, suggesting that regulatory capital requirements are effective in altering bank behavior.¹¹ Thus, from this perspective Basel III offers an important opportunity for African regulators to place a regulatory floor under actual capital ratios. However, the calibration of the capital framework and the efficacy of prudential requirements in shaping bank behavior in the African context require further research.

Higher capital requirements, however, are not panacea for financial stability. Therefore, as African countries advance their financial sector reform agenda, they might want to emphasize

¹¹ See Van Hoose (2008) for a review of the literature and Francis and Osborne (2009b) for more recent work on UK banks.

other areas which are equally critical to prevent episodes of financial fragility. In this context, policy objectives might include, among others: i) improving timely disclosure of high quality information, including comprehensive and internationally accepted accounting principles; ii) promoting the adoption of a sound corporate governance framework in order to achieve and maintain public trust and confidence in the banking system; iii) increasing compliance with the Basel Core Principles for Effective Banking Supervision; iv) strengthening the relevant legal and institutional framework, introducing a crisis management system and resolution process, and a carefully designed deposit insurance system; v) improving the quality of banking supervision.

A final caveat is in order. The findings of this paper are subject to substantial uncertainties. Data and model limitations and the difficulty of mapping capital ratios in reductions of the probability of banking crisis are factors which inevitably affect the results. Moreover, we omitted several elements from our analysis which may be important. Specifically, the assessment conducted in this paper would benefit from considering the impact of higher capital requirements on African GDP volatility. Another dimension which would enrich our assessment is the expected impact on African macroeconomic performance from tightened capital rules in the rest of the world. We leave these areas for future research.

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